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OPERATING EXPERIENCE WEEKLY SUMMARY

Office of Nuclear and Facility Safety

January 29 - February 4 , 1999

Summary 99-05

Operating Experience Weekly Summary 99-05

January 29 through February 4, 1999

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EVENTS

1. DUMP TRUCK COLLIDES WITH OVERPASS

On January 26, 1999, a Savannah River Central Services Works Engineering heavy equipment operator sustained injuries when the bed of a 16-yard dump truck she was driving collided with an overpass. Witnesses state that the bed of the truck rose shortly before it struck the overpass. A driver in a vehicle behind the dump truck attempted unsuccessfully to alert the driver of the truck. The heavy equipment operator was shaken and bruised by the collision. Facility personnel have estimated damages to the truck and overpass at more than $300,000. (ORPS Report SR--WSRC-CSWE-1999-0002)

Responding personnel transported the injured employee to the site medical facility, where she was treated and released the same day. Facility personnel erected barricades to prevent use of the overpass and its associated exits. They also contacted a bridge inspection subcontractor to assess damage to the superstructure of the overpass.

The facility manager held a critique of the accident. Attendees learned that the accident site is at least a 5-minute drive from the site from which the driver had departed with the bed lowered. The configuration of the roadway leading to the overpass rules out excessive speed as a factor. Investigators also determined that there are at least two indicators in the cab of the truck that should have warned that the bed was not fully seated.

Investigators have not yet determined why the truck bed rose as the truck approached the underpass. OE engineers will track this occurrence and will provide additional information as it becomes available.

KEYWORDS: accident, transportation, truck

FUNCTIONAL AREAS: Operations

2. MODULATOR FIRE AT THE NATIONAL SYNCHROTRON LIGHT SOURCE

On January 25, 1999, at the Brookhaven National Laboratory National Synchrotron Light Source (NSLS), three operators tried but failed to extinguish a fire that occurred in a modulator. The modulator is a refrigerator-size cabinet that contains a bank of ten 60-kV capacitors that are inside the cabinet. The capacitors nominally operate at approximately 32 kV. Before the fire started, the operators heard loud noises in the modulator area and responded. They turned off the modulator high-voltage disconnect switch and the noises stopped. The area smoke alarms activated as the operators were requesting assistance from modulator technical personnel. The alarms sent a signal notifying fire and rescue personnel of the fire. The operators responded to the alarm and saw flames and smoke coming from inside the modulator cabinet. They did not have a key to open the modulator door, so they discharged several Halon and dry chemical fire extinguishers through a grill in the bottom of the door. The smoke was very heavy when fire and rescue personnel arrived at the scene, so the operators pulled the evacuation alarm. All ten or so facility personnel evacuated the building. Fire and rescue personnel pried open the modulator cabinet door and extinguished the fire. The fire, which occurred at approximately 0030, was contained within the modulator. Investigators believe that it was caused by a failed capacitor. This event resulted in property damage estimated at $30,000, extensive smoke and soot cleanup activities, and the shutdown of the NSLS until repairs can be completed and interim actions taken. (ORPS Report CH-BH-BNL-NSLS-1999-0001)

Investigators determined that the operators had used Halon and dry chemical fire extinguishers to try to put out the fire, which was suppressed and flared up again after each extinguisher was discharged. Investigators believe that a low-voltage cooling fan installed on top of the modulator was exhausting the Halon from inside the modulator, thereby preventing the fire from being fully extinguished. They determined that when the operators shut off the high-voltage disconnect switch it did not de-energize the fan. Investigators also determined that when fire and rescue personnel opened the modulator door they noticed that control lights on the cabinet were lit. Plant engineering electrical staff personnel turned off the breakers to all of the modulators to ensure that no equipment remained energized. Investigators determined that the operators had not shut off the low voltage to the modulator nor were they aware how to secure the low voltage. They determined further that because all three of the operators on shift were attempting to extinguish the fire, the control room was unmanned and the NSLS remained running. After the fire, the operators re-entered the facility, accessed the control room, and shut down the NSLS. Investigators determined that the operators did not completely follow the facility emergency procedure for a fire. Figure 2-1 shows an undamaged modulator cabinet. Figure 2-2 shows the modulator cabinet after the fire.

Figure 2-1. Undamaged Modulator Cabinet

Figure 2-2. Fire-Damaged Modulator Cabinet

Investigators determined that the capacitors were oil-filled (non-PCB), had polyethylene cases, were supported by fiberglass racks, and used timing tuning coils wrapped around polyvinyl chloride piping, resulting in approximately 10 pounds of plastic inside the modulator. The burning plastic caused dense smoke during the fire. Facility personnel have completed modulator repairs and testing of a newly installed modulator. The NSLS has restarted. The facility chairman appointed an investigation committee to review the event. In addition, the following interim actions have been performed.

- Workers installed quick shutoff switches that de-energize the high- and low-voltage power to the modulator as well as the cooling fan. They installed these at all three modulators and in the control room.

- Facility personnel modified operations so as to energize the modulator only when it is required for National Synchrotron Light Source operation (approximately 1 hour a day during the injection phase) instead of continuously.

- An operator is required to be on standby in the area whenever the modulator is operating and to be in possession of emergency instructions and a Halon fire extinguisher.

NFS reported a facility fire and the results of the associated Type B investigation report in Weekly Summaries 94-40 and 94-14. On March 31, 1994, there was a fire and a release of contamination at the TRISTAN experiment at Brookhaven National Laboratory. The experiment involved an on-line isotope separator located at a beam port of the High Flux Beam Reactor. The fire, which occurred on the midnight shift, caused $222,000 worth of damage. Investigators identified the direct cause of the fire as a faulty electrical feed connection that was close to combustible insulating materials. Investigators also identified several concerns regarding the lack of procedures and availability of experienced personnel. They learned that operators did not understand the meaning of certain alarms. Health physics personnel were required to respond to

the alarms, but they were not available on the midnight shift. Also, operators and firefighters did not know how to de-energize electrical power to the experiment until an experienced TRISTAN technician arrived. There were no procedures for responding to an alarm or for electrically isolating the experiment in an emergency. (ORPS Report CH-BH-BNL-HFBR-1994-0005; "Type B Investigation of the March 31, 1994, Fire and Contamination at the TRISTAN Experiment, High Flux Beam Reactor, Brookhaven National Laboratory, Upton, NY")

Facility managers should ensure that operators are trained in emergency operating procedures and understand that the procedures must be followed. They should also ensure that qualified personnel are available to support off-shift working hours as well as weekends and holiday shifts. Operators should be particularly aware of personal safety in abnormal situations.

- DOE O 5480.19, *Conduct of Operations Requirements for DOE Facilities*, chapter I, "Operations Organization and Administration," states that a high level of performance is accomplished by (1) establishing high operating standards, (2) ensuring personnel are well trained, and (3) holding workers and their supervisors accountable for their performance in conducting activities. Chapter XVI, "Operations Procedures," requires that operations procedures provide direction to ensure the facility is operated safely.

- DOE O 5480.20, *Personnel Selection, Qualification, Training, and Staffing Requirements at DOE Reactor and Non-Reactor Nuclear Facilities,* states that the purpose of the Order is to assure that all persons are qualified to carry out their assigned responsibilities. Chapter I, sections 7.a.(1) and 7.a.(2), provide requirements for developing and maintaining training to meet the position requirements.

KEYWORDS: emergency operating procedures, operator, fire, conduct of operations

FUNCTIONAL AREAS: Fire Protection, Operations, Procedures

3. NEAR MISS WITH GRINDING WHEEL

On January 26, 1999, at the Hanford Site, a pipe fitter was grinding slag from the flame-cut edge of a 3/8-inch thick metal plate when the grinding wheel, a 6-inch-diameter cup stone, disintegrated. The guard of the hand-held pneumatic grinder protected the pipe fitter and deflected the broken pieces away and down toward the floor. The largest segment traveled approximately 15 feet and struck a metal garbage can, penetrating one side of the can and propelling it approximately 15 feet. Other fragments were distributed over an area with approximately a 12-foot radius. There were no injuries, and property damage was limited to the grinding wheel and the garbage can. (ORPS Report RL--PHMC-FSS-1999-0006)

The pipe fitter stopped work and notified his immediate supervisor. The facility manager immediately ordered shop personnel to halt all grinding operations pending completion of an inspection of all grinding wheels in the facility for visible damage and verification that no wheels were mounted in grinders having rated speeds greater than the allowable wheel speed. The only grinder capable of exceeding the rated maximum speed of any grinding wheel in the facility was the grinder associated with this event, and the facility manager ordered that it be removed from service. Figure 3-1 shows the damaged garbage can. Figure 3-2 shows the grinder and pieces of the cup stone.

Figure 3-1. Damaged Garbage Can

Figure 3-2. Grinder and Pieces of Cup Stone

Investigators determined that the pipe fitter was wearing safety glasses with side shields, a full-face grinding shield, ear protection, leather gloves, safety-toed shoes, and long-sleeved coveralls. A protective grinding/ultraviolet flash shield was in place between the grinding operation and nearby employees. Investigators also determined that the pipe fitter had performed a pre-use visual inspection of the cup stone and grinder and did not observe any chipped areas, cracks, or other damage. They also determined that the cup stone label indicating rated speed and stone composition was not legible. They later determined that the stone was rated for up to 6,000 rpm and that the grinder was rated for 7,700 rpm. Investigators have not yet determined (1) how this wheel came to be mounted on this grinder, (2) what the facility requirements are for testing and inspecting grinding wheels, or (3) when the disintegrated wheel was last tested. Investigators are

trying to fully determine the cause of the grinding wheel failure and the appropriate corrective actions.

This occurrence underscores the hazards associated with the use of grinding wheels. Although relatively rare, the disintegration of a spinning grinding wheel in use is a highly energetic event and can propel pieces of the wheel or the grinder itself at great speeds, injuring the user or bystanders or causing property damage. Facility managers should ensure that grinders do not subject grinding wheels to speeds greater than the maximum operating speed of the wheel and that wheels are inspected and tested at appropriate intervals. The following references provide safety-related information on grinding wheels.

- 29 CFR 1910.243, *Guarding of Portable Power Tools,* and 29 CFR 1910.215, *Abrasive Wheel Machinery,* both state that "immediately before mounting, all wheels shall be closely inspected and sounded by the user…to make sure they have not been damaged in transit, storage, or otherwise. The spindle speed of the machine shall be checked before mounting of the wheel to be certain that it does not exceed the maximum operating speed marked on the wheel." 29 CFR 1910.215, *Abrasive Wheel Machinery,* adds that before mounting, "wheels should be tapped gently with a light nonmetallic implement, such as the handle of a screwdriver for light wheels, or a wooden mallet for heavier wheels. If they sound cracked (dead), they shall not be used. This is known as a 'ring test.' Wheels must be dry and free from sawdust when applying the ring test, otherwise the sound will be deadened. It should also be noted that organic bonded wheels do not emit the same clear metallic ring as do vitrified and silicate wheels."

- ANSI B7.1-1988, *American National Standard Safety Requirements for the Use, Care, and Protection of Abrasive Wheels,* also requires the user to visually inspect abrasive wheels before mounting them and to apply suitable crack detection tests, such as the ring test. It states that the maximum speed is the "…speed which the tool can achieve under the most adverse condition of possible misadjustment or malfunction of any of its speed control devices, when supplied with compressed air at 90 psig." The standard further states that "it is of special importance that portable air grinders should be checked to be sure that proper air pressure is maintained and that the machine governor mechanism is clean, in good operating condition, and functioning properly." The standard recommends measuring the speed of portable air-driven grinders every 20 hours of actual use or once per week, whichever comes first. It also recommends measuring the speed of all types of grinders after maintenance or repair, whenever a grinder is issued from the tool crib, and at each wheel change.

- ANSI B186.1, *Safety Code for Portable Air Tools*, provides type, dimensions, and specifications of abrasive wheels used on portable air grinding machines.

Additional information is available from the Grinding Wheel Institute at http://www.nauticom.net/users/grind/gwi.html and the Abrasive Engineering Society at http://www.nauticom.net/www/grind/.

KEYWORDS: grinding, industrial safety, inspection

FUNCTIONAL AREAS: Industrial Safety

4. 480-V LINE SEVERED DURING SNOW REMOVAL

On January 20, 1999, at the West Valley Demonstration Project in the High Level Waste Tank Farm, a heavy equipment operator severed a 480-V extension cord when the bucket of the front-end loader that the operator was using to remove snow struck it. On January 1, 1999, workers had run the extension cord approximately 120 feet along the ground from an outdoor breaker box to an electric space heater. Several feet of snow fell and had to be removed to allow fork truck operation in the tank farm. The extension cord was not identified in the walk-down and was not discussed in the pre-job planning. There were no personnel injuries and no equipment damage other than the severed cable. (ORPS Report OH-WV-WVNS-HLLW-1999-0001)

Investigators determined that the extension cord was being used to bring power to an electric space heater in a condenser shelter to prevent freezing of condensate when the weather turned cold. They also determined that awareness of the heater and extension cord decreased over time to the point where they were not considered before snow removal.

The High Level Waste Projects Manager formed a team to perform a formal root cause investigation of the event. The team identified the following root causes.

- There is no site policy outlining expectations for hazard identification before snow removal. Snow removal is considered routine. However, because of the potential for damage to equipment and components, snow removal using heavy equipment in the Waste Tank Farm should not be considered routine.

- The policy for marking and/or protecting equipment and components (including portable equipment, cords, and other utilities) does not outline what is expected when there is a potential for equipment and components to be buried or covered.

- The freeze protection afforded by the condenser shelter is inadequate and requires a permanent solution.

The responsible managers are developing corrective actions to address these root causes.

NFS reported a similar occurrence in Weekly Summary 98-01. Construction workers at the Monticello Remedial Action Project repository severed a temporary, partially buried, energized 480-V cable with a front-end loader. They severed the cable while moving a pile of sand that had been dumped in the area above the cable. The cable connected a portable diesel-driven generator to a power distribution panel located next to a decontamination pad at the repository. Investigators reported that construction personnel originally installed the cable on top of the ground. However, because of foot and vehicular traffic over a period of several months, the cable became buried to a depth of 2 to 3 inches. (ORPS Report ALO--MCTC-GJPOTAR-1997-0014)

OEAF engineers reviewed the ORPS database and discovered a similar event, also at the Monticello Remedial Action Project decontamination pad, where an energized 480-V temporary cable was severed when a subcontractor struck the cable with a grader while removing snow. The facility manager attributed the recurrence to a failure of management to fully and effectively implement corrective actions prescribed for the earlier event. (ORPS Report ALO—MCTC-GJPOTAR-1998-0001)

Personnel should also consider a similar potential for portable equipment, cords, and other utilities to become obscured by vegetative growth. Weekly Summary 95-46 reported two separate occurrences where electrical cables were cut by grass mowing machinery. (ORPS Reports SR--WSRC-REACP-1995-0027 and CH-AA-ANLE-ANLEERD-1991-1001)

Using extension cords to power portable equipment is a common practice. However, personnel must recognize that temporary situations can become long-term or permanent. Because configuration control for portable equipment is less rigorous than for permanent equipment, temporary installations of portable equipment are easily forgotten or overlooked and can lead to an unsafe work environment. It is important to recognize the potential hazards of any electrical installation, whether it is considered portable, temporary, or permanent. The use of portable electrical equipment to provide long-term solutions and temporary electrical modifications should be minimized.

The space heater was considered portable equipment powered through extension cords, not a temporary modification to the condenser shelter. Some of the following references may apply only to temporary modifications. National Electric Code, Article 305, *Temporary Wiring,* and 29 CFR 1926, subpart K, "Electrical," include provisions that apply to temporary electrical power and lighting wiring methods, which may be of a class less than would be required for a permanent installation at a job site. Commentary included with Article 305-2 of the 1996 National Electric Code requires that all temporary wiring methods must be approved based on criteria such as (1) length of service, (2) severity of physical abuse, (3) exposure to weather, and (4) other special requirements. 29 CFR 1926.400, "Introduction," addresses electrical safety requirements that are necessary for the practical safeguarding of employees involved in construction work. It also includes applicable definitions. Subparts 1926.416 and 1926.417 contain information on and requirements for safety-related work practices. In addition to covering the hazards arising from the use of electricity at job sites, these regulations also cover the hazards associated with accidental contact, direct or indirect, by employees with all energized lines, above- or below-ground, passing through or near the job site.

KEYWORDS: electrical, freeze protection, temporary modification

FUNCTIONAL AREA: Industrial Safety

5. FALLING HOIST LOAD CHAIN RESULTS IN NEAR MISS

On January 25, 1999, in an assembly/disassembly bay at the Pantex Plant, a load chain for an air-operated hoist fell from its retaining bucket, missing the hoist operator. The load chain failed to fall into the retaining bucket as it was designed to do. When a number of links from the load chain were outside the bucket, gravity pulled the remaining length of chain from the bucket, causing it to fall to within 3 feet of the bay floor. The operator was retracting the hook to its stored (up) position at the time the chain fell. He was unaware of the falling chain until a coworker heard the sound of the chain and alerted him. The operator immediately moved out the way, unharmed. No explosive or nuclear material was present in the bay at the time of the event. Although there was no injury, the potential existed for injury or equipment damage. (ORPS Report ALO-AO-MHSM-PANTEX-1999-0004)

The production technicians in the bay immediately stopped using the chain hoist, which can also be referred to as a jib crane, and contacted the operations manager, the assistant facility manager, and the DOE facility representative. The hoist trolley is mounted on a rail of the jib approximately 12 to 15 feet above the floor. The jib is attached to a wall and can be positioned through an arc by means of a rope attached to its end. The retaining bucket is made of sheet metal and is 8 inches long, 3 inches wide, and 10 inches deep. Production technicians use two ropes to operate the “up” and “down” controls for the hoist. Figure 5-1 shows two examples of jib cranes.

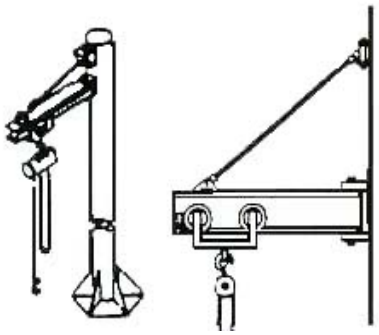

Figure 5-1. Jib Cranes

The facility manager conducted a critique of the event on January 26 and determined that the operator was moving the chain hoist away from the workstation when the load chain fell outside the chain bucket. Crafts personnel and facility personnel believe that the positioning of the anchor point for the load chain may also have contributed to the event because it allowed the chain no slack. When the hoist hook was raised, the load chain started into the bucket but became misaligned, spilling over the side of the bucket. As an interim action, personnel positioned the anchor point for the load chain at a point that gave approximately 3 feet of chain in the bucket. This length would allow gravity to determine a path for the load chain that would cause it to enter the bucket properly but would still provide sufficient travel for required air hoist operations. Operators were cautioned not to move the hoist trolley or position the jib while raising the load chain because doing so could cause the bucket to tilt as the chain played into the bucket.

Pantex personnel reported another event in ORPS in which the in-haul chain spilled out of the retaining bucket of an air-operated hoist. Investigators discovered that the retaining bucket had semicircular openings at the top of the two vertical sides. Although the bucket had adequate capacity to collect the chain below the openings, the chain stacked up on one side of the bucket during this particular lift and spilled out through the opening. Crafts personnel replaced the bucket with a larger bucket that had metal covers over the side openings. (ORPS Report ALO-AO-MHSM-PANTEX-1995-0219)

The proper use of a chain bucket with a hoist can help contain the free end of the chain and prevent it from causing a problem like the one experienced at the Hanford Site and reported in Weekly Summary 98-01. A 55-gallon drum containing radiological waste slipped free of its rigging and fell approximately 8 feet. Investigators determined that as operators lowered the drum, the free end of the hoisting chain caught on the drum lid closure ring bolt. The free end of the chain had been moving upward, relieving the load on one of the barrel hooks of the lifting sling. The drum then tilted, causing the rigging to disengage from the drum. Investigators also determined that the hoist was not equipped with a chain bucket. Such a bucket would have prevented the free end of the hoist chain from coming in contact with the load, but procedures did not require one.

NFS has reported numerous hoisting and rigging events in the Weekly Summary. Some examples involving small hoists follow.

- Weekly Summary 96-51 reported that a construction worker at the Pantex Plant was injured when a 250-pound steel plate knocked him from a stepladder and he fell 4 feet to the floor. Two construction workers were lifting the plate with a hand-operated chain hoist. At 9 feet above the floor, the chain disengaged from the plate lifting device and the plate dropped. Because the chain was not properly rigged, it came loose when the worker shook the load to clear an obstruction. (ORPS Report ALO-AO-MHSM-PANTEX-1996-0239)

- Weekly Summary 96-40 reported two events involving problems with hoisting equipment at Savannah River. At the Receiving Basin for Offsite Fuels, a 2-ton chainfall rolled off the end of a monorail. The trolley did not have a mechanical stop. At the Laboratory Technical Area, while riggers were lifting a pipe with a 2-ton underhung electric hoist, a hoist cable snapped, dropping the 20-foot-long, 18-inch-diameter pipe approximately 5 feet. The pipe became wedged 10 to 12 feet above the floor. There were no injuries in either occurrence; however, the potential for injury existed. (ORPS Reports SR--WSRC-RBOF-1996-0020 and SR--WSRC-LTA-1996-0035)

These events illustrate the importance of observing safe hoisting and rigging practices. The following references should be understood by personnel involved in hoisting and rigging.

- DOE-STD-1090-96, *Hoisting and Rigging*, provides guidance for hoisting and rigging and identifies related codes, standards, and regulations. Chapter 8, "Hoists," provides safety standards for inspecting, testing, and operating hoists that are not permanently mounted on overhead cranes. It contains the requirements of ASME B30.11, *Monorail Systems and Underhung Cranes*, B30.16, *Overhead Hoists (Underhung)*, and B30.21, *Manually Lever Operated Hoists*.

- The DOE Office of Oversight publication *Independent Oversight Special Study of Hoisting and Rigging Incidents within the Department of Energy,* October 1996*,* analyzes DOE hoisting and rigging incidents between October 1, 1993, and March 31, 1996. The analysis shows that three out of four hoisting and rigging incidents resulted in accidents in which personal injury, property damage, or both were incurred. Half of all hoisting and rigging incidents were associated with the use of crane equipment. Seventy-four percent of crane incidents resulted in accidents. Inattention to detail, closely followed by deficiencies in work organization and planning, was the leading causes of crane incidents. The analysis can be found at http://nattie.eh.doe.gov/web/eh2/reviews/hoist_rig.html.

KEYWORDS: crane, hoist, hoisting and rigging, near miss

FUNCTIONAL AREAS: Hoisting and Rigging, Industrial Safety

6. SUBCONTRACTOR CUTS ENERGIZED CONDUCTOR WITH POWER SAW

On January 28, 1999, at the Kansas City Plant, a construction subcontractor cut into a conduit that contained an energized three-phase, 480-V cable. The cut was made by a reciprocating power saw. When the saw blade penetrated the 1-1/2 inch diameter metal conduit and the cable, an electrical arc occurred, blowing fuses in a bus tap switch. A supervisor had directed the subcontractor to cut the wrong conduit. The subcontractor immediately stopped work and left the room. A security escort secured the scene and gave proper notification. Medical personnel examined the subcontractor and determined that no injury had occurred. The subcontractor was fortunate not to have received an electrical shock. (ORPS Report ALO-KC-AS-KCP-1999-0003)

The subcontractor was a part of a four-member team that was removing conduit in a room with mercury contamination. He wore personal protective equipment (PPE) intended to protect against the mercury hazard but not the electrical hazard. The PPE consisted of rubber boots, neoprene-coated rubber gloves, a protective suit, and a full-faced respirator.

Investigators determined that the work supervisor had reviewed the work plan with a subcontractor electrician. The electrician identified the conduits to be cut and had them de-

energized and locked and tagged out. He also pulled the wires from the conduits and disconnected the conduits from their termination points. In addition, he performed a zero- energy check to ensure there was no electrical hazard. Investigators also determined that approximately 3 days had elapsed between the supervisor's work plan review and the incident. They believe the work supervisor forgot which conduits were cleared for cutting and instructed the subcontractor to cut the wrong one. The conduits in the room were not marked by, for instance, tagging or painting to ensure that the correct ones were removed. Facility personnel are evaluating various causal factors and corrective actions.

Care needs to be exercised if spray painting is to be used to mark items for removal. Weekly Summary 93-43 reported an event at Argonne National Laboratory—East in which workers inadvertently severed an energized wire during decontamination and decommissioning activities because the conduit was incorrectly marked. The Laboratory's standard procedure for designating that components were ready for removal was to mark them with orange spray paint. When workers spray-painted the conduit to be removed, paint overspray accidentally marked an adjacent cable that was energized. Workers mistakenly concluded that the cable could be safely removed. The cut cable caused a loss of power to lighting and ventilation and the building had to be evacuated. (ORPS Report CH-AA-ANLE-ANLEEWM-1992-0004)

NFS has reported numerous events in which energized electrical cables were cut. Some examples follow.

- Weekly Summary 98-29 reported that three subcontractor electricians at the Strategic Petroleum Reserves Bayou Choctaw Site were holding energized 480-V cables while cutting the conduit that contained the cables with a band saw. Although the electricians were trained and qualified, they cut the conduit in violation of their work permit and site safety procedures that require equipment to be locked out and tagged out. (ORPS Report HQ--SPR-BC-1998-0003)

- Weekly Summary 97-14 reported that decontamination and decommissioning workers cut through a conduit into an energized 220-V cable at the Hanford N-Reactor. Markings on the conduit indicated the cable was de-energized and a zero-energy check had been completed. When the workers cut the conduit and wire they observed arcing and sparking. Investigators determined that the workers bypassed a procedural hold-point and that an electrician had not conducted a zero-energy check. (ORPS Report RL--BHI-NREACTOR-1997-0006)

- Weekly Summary 96-17 reported that a contractor at Los Alamos National Laboratory received a mild electrical shock when he cut through an energized 220-V cable during asbestos abatement in the Chemistry and Materials Research Facility. The contractor cut the cable and stopped when he saw sparks. Investigators determined that mismanagement of two separate contractors' work scopes and the inaccuracy of the building configuration documentation were causal factors. (ORPS Report ALO-LA-LANL-CMR-1996-0016)

These events underscore the hazards involved when energized cables are accidentally cut. Managers and supervisors overseeing the removal of electrical cables should stress electrical safety techniques to their workers; such techniques include verifying that wires are de-energized by making an electrical check before cutting and verifying that supply breakers are tagged/locked out. Work supervisors and foreman should not rely on memory alone when directing work activities. Work instructions, marked-up drawings, and marked, labeled, or tagged components can be helpful to ensure the correct components are being worked on. Also, appropriate PPE should be prescribed for all workplace hazards. Managers and supervisors should review the following guidance.

- U.S. Department of Labor, Occupational Safety and Health Administration standard "Selection and Use of Work Practices," 29 CFR 1910.333, provides detailed guidance on electrical safety techniques during maintenance and construction.

- DOE/ID-10600, *Electrical Safety Guidelines*, section 2.13.2, states: "A qualified worker shall use test equipment to test the circuit elements and electrical parts of equipment to which employees will be exposed and shall verify that the circuit elements and equipment parts are de-energized." Personnel should check with a qualified electrician before cutting or disconnecting wires if it is not obvious to the eye that the wires are de-energized.

- Lessons Learned Report, Issue 98-02, *Penetrating Hidden Utilities,* includes lessons learned from events that involved cutting and drilling into utilities concealed behind walls, floors, and ceilings. It also describes a number of techniques for avoiding hidden utilities and includes useful references. Lessons Learned Reports are available at the website http://www.tis.eh.doe.gov/web/oeaf/lessons_learned/reports/.

- DOE/EH-0557, Safety Notice 98-01, *Electrical Safety*, contains summaries, corrective actions, and recommendations related to electrical events. It notes that more than 800 occurrences involving electrical safety have been reported in ORPS between January 1990 and June 1998. Type A accident investigations have been conducted for five electrical accidents, three of which were fatal. Safety Notices are available at http://tis.eh.doe.gov/web/oeaf/lessons_learned/ons/ ons.html.

KEYWORDS: cable, conduit, electrical hazard, electrical shock

FUNCTIONAL AREAS: Hazards Analysis, Industrial Safety

7. STOP-WORK ORDER ISSUED FOR POWERED AIR-PURIFYING RESPIRATORS

On February 3, 1999, at the Fluor Daniel Hanford Site, a respirator protection program administrator issued a stop-work order for all work involving the use of Mine Safety Appliance (MSA) powered air-purifying respirators (PAPRs). He discovered five fractured MSA coupling nuts on 19-inch hood breathing tubes, all of which were new. The tubes have plastic coupling nuts on both ends that connect the PAPRs to MSA blower units. The respirator protection program administrator notified MSA personnel of the fractured coupling nuts. They believe that the failures resulted from a solvent attack on the polycarbonate material during the manufacturing process. These failures are a continuation of coupling nut failures that have been occurring at Hanford since 1996. Failure of coupling nuts while wearers are working in airborne radiological areas could result in radiological uptakes.

Investigators determined that all of the nuts fractured horizontally and that all of the failures were associated with MSA OptimAir 6 PAPR (see Figure 7-1). Respiratory protection personnel restricted use of these models and notified the National Institute for Occupational Safety and Health of the coupling nut failures. Respiratory protection personnel will contact manufacturers to determine what other similar respirators are available for use in the event that MSA does not provide an acceptable resolution of this problem. Industrial hygienists will assist workers in selecting the proper respirator to be used in place of the MSA PAPR.

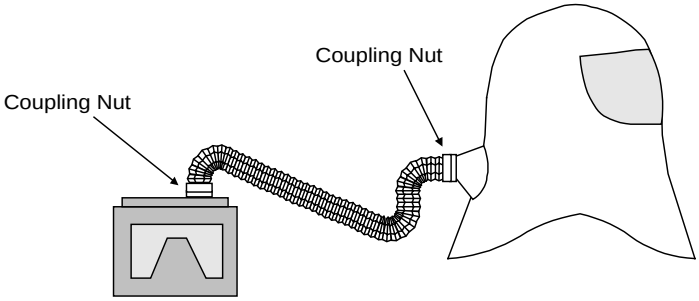

Figure 7-1. MSA OptimAir 6 PAPR

The MSA product lines manager initially stopped all shipments of the PAPR following a similar event at Hanford in September 1998. As a result of that event, MSA changed to a solvent-resistant plastic for manufacturing the coupling nut and issued field inspection test instructions so all PAPRs that contain the polycarbonate coupling nuts can be checked before use. However, these actions have been ineffective in preventing recurrence.

NFS has reported coupling nut failures at Hanford in several Weekly Summaries. In addition, OEAF engineers searched the ORPS database and found a similar event. Some examples follow.

- Weekly Summary 98-40 reported that a respirator protection program administrator discovered that five fractured MSA coupling nuts had been found on 19-inch hood breathing tubes, three of which were new and still in the manufacturer's boxes.

- On April 26, 1996, a T-Plant nuclear process operator reported three discoveries of fractured MSA coupling nuts on 19-inch hood breathing tubes. (ORPS Report RL--WHC-TPLANT-1996-0005)

- Weekly Summary 96-18 reported that a T-Plant operator experienced reduced airflow through his replaceable hood shell, which was connected to a hood breathing tube and a powered air-purifying respirator. He checked the coupling nut and found that it rotated freely. Initially, Hanford investigators thought the reduced airflow coupling nut failure was caused by an overtightening of the nut. T-Plant investigators determined that the failures continued to occur on replacement coupling nuts supplied by MSA. MSA later identified several deficiencies in the coupling nut production process. (ORPS Report RL--WHC-TPLANT-1995-0030)

Facility managers and personnel in charge of training workers on respirator usage should emphasize the importance of carefully checking for respirator defects before entering areas that require respiratory protection. Personnel who wear respirators should ensure that they understand and implement the correct methods of wearing, operating, and checking the respirators. DOE/EH-0256T, *Radiological Control Manual*, 29 CFR 1910.134, *Respiratory Protection*, and ANSI Z88.2-1992, *Respiratory Protection*, discuss equipment and requirements of respiratory protection programs and provide additional references.

For more information on the coupling nut failures, contact Cliff Ledford, Fluor Daniel Hanford Respiratory Protection Program administrator at (509) 373-5214 or at troy_c_cliff_ledford@rl.gov. MSA maintains a website at http://www.msanet.com.

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FUNCTIONAL AREAS: Radiation Protection, Industrial Safety, Lessons Learned